Chapter 5

Investigating Auto Injury Treatment in a No-Fault State: An Analysis of Linked Crash and Auto Insurer Data

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Abstract

Hawaii is a no-fault insurance State which provides for choice of a variety of alternative therapies for motor vehicle injury victims. The two most frequently used providers are medical doctors (MD) and doctors of chiropractic (DC). A large portion of this care is rendered in office visits, and can be readily identified from insurance payment records. The focus of this study is the distribution of these types of direct medical care across crash types and circumstances. Study data include police crash reports and 6,625 closed case files of a Hawaii auto insurer for the years 1990 and 1991. The files were linked with Automatch, a probabilistic record linkage program, using crash date, crash time, gender and birth date as match fields (Kim and Nitz, 1995; Matchware Technologies, 1996). The insurance payment file indicates the type of treatment received by persons injured in collisions. The study asks two questions about the choice of care among crash victims:

- *Who goes to a chiropractor?*
- *What is the relationship between occupant, vehicle and crash characteristics and the choice of care?*

Background

Hawaii has had a no-fault insurance system for over twenty-five years (HRS 431:10C). The program was initially introduced to assure the availability of automobile liability insurance to all residents without age or gender discrimination. Underwriting is limited to rate adjustments based on the driving record of the individual applicant (HRS 531:10C-111(c)). The program, since its inception, provided that each motor vehicle operator's own insurance carrier would provide coverage for personal injury protection (PIP) for all injuries to the operator or his or her passengers, without examination of the issue of fault, up to a certain value, the medical-rehabilitative limit, or "tort floor," (HRS 431:10C-103(10)(c). This was $15,000 in 1990.) Injury costs beyond this value could be recovered from a party deemed to be at fault through a tort action in the courts. Each vehicle operator's auto policy was also required to provide at least a minimum level of bodily injury (BI) protection for others who might be injured by the insured driver. This BI coverage could normally only be touched in the event that the injured party had reached the tort floor by claims against his or her own PIP coverage or had no PIP coverage. (A pedestrian, for example, would be able to make a BI claim directly.) Insurance carriers also offered additional coverage for uninsured and under insured motorists (UI and UIM). Hawaii drivers typically purchased these coverages to protect against catastrophic losses that might be incurred should they be in a collision with an un- or under-insured motorist. In the event that all available coverages had been exhausted, the injured party's medical insurer was held responsible for all remaining medical expenses. The medical insurer was deemed not responsible for any

auto-related injury cost prior to the exhaustion of auto policy benefits.

The State Insurance Commissioner is authorized to adust the *tort floor*, every year to set a level at which 90% of all injury claims will be covered by PIP without resort to a suit (HRS 431:10C-308). In 1990, the tort floor was $15,000. If total medical and rehabilitation expenses and loss of wages exceeded this value, the patient could file a tort suit. Tort suits could be filed without respoect to monetary values for permanent and serious disfigurement, permantent loss of use of a body part, or death. In addition, the Insurance Commissioner set an annual "medical rehabilitative limit," a value of medical and rehabilitative expenses which would be sufficient to permit filing of a tort suit. The medical rehabilitative limit for 1990 was $7,000, and for 1991 was $7,600. Until recent reform legislation passed in 1994, the auto injury patient's choice of medical care facility and the scheduling of therapies recommended was very broad (HRS 431:10C-103(10)(A)(i)).

> "All appropriate and reasonable expenses necessarily incurred for medical, hospital, surgical, professional, nursing, dental, optometric, ambulance, prosthetic services, products and accommodations furnished, and x-ray. The foregoing expenses may include any non-medical remedial care and treatment rendered in accordance with the teachings, faith or belief of any group which depends for healing upon spiritual means through prayer...."

In this context of open benefit provisions, the state has shown dramatic growth in the availability of chiropractic services, pain clinics, physical therapy facilities, and massage therapy practitioners.

The 1992 legislative session (1992 Hawaii Session Laws Act 123, Sec.7) put the auto injury treatment allowances on the same regimen as the disability-graded allowances for workers' compensation medical care and rehabilitative therapy (HRS 431:10C-308.5). The fact that there has been broad choice of type and amount of therapy for many years suggests that it might be useful to understand the relationships between objective features of the crash event and the actual choice of care. To make this analysis possible, it was necessary to link an auto insurer's payment file to the police motor vehicle accident report file. The next section outlines the data and procedures used to make this linkage.

Data

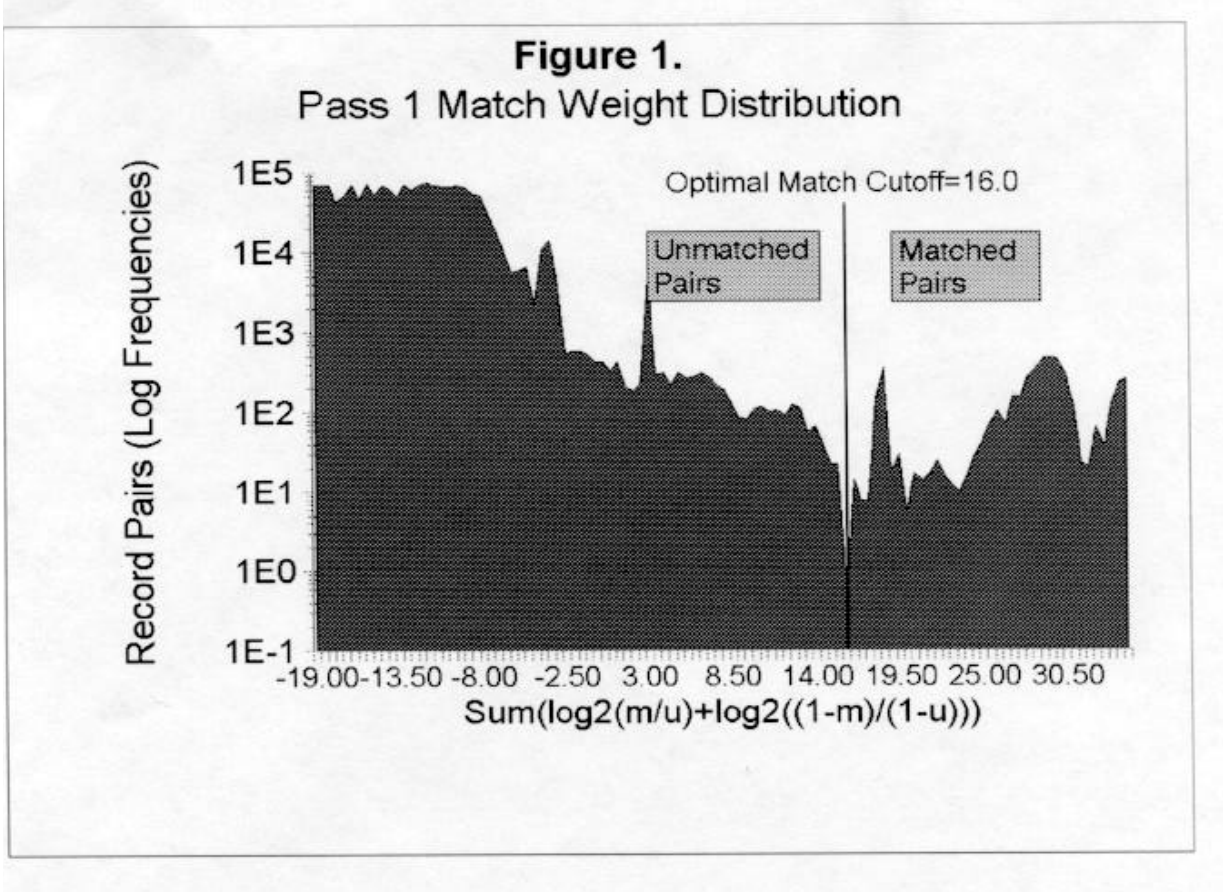
The police crash report file is maintained by the Hawaii State Department of Transportation. The four county police departments in Hawaii are required to report every motor vehicle collision on a public road which involves an injury or death or estimated damages of $1,000 or more (in 1990). The reporting form contains extensive description of the crash circumstances, features of the roadway and traffic environment, and driver characteristics. Where an injury has been reported, it also contains the police officer's description of the severity of injury on a five-level scale (K = killed, A = incapacitating injury, B = non-incapacitating injury, C = possible injury, and 0 = no injury). Drivers were also identified by their birth dates. Two years, 1990 and 1991, form the pool of reported motor vehicle collisions for this analysis.

The insurance file consisted of 6,625 closed case records of a Hawaii auto insurer for the years 1990 and 1991. The file contained the closing accounting records on these cases, showing the total of all sums paid out, and the elementary data on the characteristics of the crash and the injured party. All records represented claims actually paid; the maximum payment is the policy limit chosen by the insured in buying the policy. For this particular group of policies, the maximum policy limit the company offered was $300,000. Any additional coverage that might have been carried by way of an umbrella clause appeared in a different set of accounts. Injured persons were identified by birth date, gender, and date and time of the collision. The crash date, crash time, gender and driver age are common to both files, and provide a basis for linking the insurance payouts to details on the crash itself. Another insurance file contained details of about 58,000 transactions recording specific payments made in processing the claim. This file was initially processed by

extracting the payee field as a SAS character field, and parsing it for common character combinations of the license designations MD (Medical Doctor) and DC (Doctor of Chiropractic). The file was then summed by claimant; applicable office call charges for MD and DC services were used to create separate analysis variables. This summary file was then merged with the matched crash and insurance event record file.

The Matching Procedure

Matchware Technologies's Automatch 4.0 was used to match the crash and the closed case file in three steps (Matchware Technologies, 1996). (See Kim and Nitz, 1995, for a more extensive discussion of the Automatch application.) Pass 1 divided the file into homogeneous blocks based on age and sex, and matched on time of crash, date of crash, and birth date. The log frequency distribution of the Fellegi-Sunter match weights for Pass 1 is shown in Figure 1. For Pass 1, 2,565 record pairs were designated as matches, with match weights meeting or exceeding the cutoff value. The optimal cutoff for the first pass was 16.0, which marks a relatively clear division in the distribution, as indicated in Figure 1. (The count of nonmatches with match weights of -19 and lower was truncated at 80,000 pairs, and the observed frequencies (+.5) were logged for display purposes.)



Pass 2 blocked on date of crash and sex, and matched on time and birth date. An additional 1,001 record pairs were selected as matches with a criterion value of 12.0. Pass 3 was designed to pick up erroneous

recording of military time values. A field was created in the driver crash record which recoded afternoon and evening times into the 12-hour time scale. The cases were blocked on date and birth date and matched on sex and the 12-hour time value. Only seven additional cases were identified, using a criterion value of 7.0, to produce a total matched set of 3,573 cases. (The analyses to follow report the smaller numbers with complete information on crash characteristics of interest.)

ID values were extracted from the match output file and used to index the matching cases in the crash report, EMS run report, and insurance case files. These were then directly merged by common ID values in a SAS step.

Match Results

A comparison of the distributions of the police crash file and the matched file suggest parallel profiles for temporal and environmental crash characteristics. Of the insurance cases, 3,573 (54%) were matched to drivers and other principals identified by birth date in the crash file. There were no significant differences in the two distributions by intersection/mid-block location (Chi-square=.51, 1 df, p<.48, phi=.002), month (Chi-square 5.77, 11df, p<.89, phi=.008) or day (Chi-square= 4.09, 6 df, p<.66, phi=.007). The profiles for time distribution by hour, urban/rural location, and daytime and nighttime peak traffic periods showed significant, but low level differences (phi coefficients generally <.02). Gender, human factor, and police judgements of injury severity differed substantially across the two files, with the matched insurance file being more seriously injured (57% of insurance claimants denoted "not injured" versus 74% of the police report file), more female (46% female in the insurance file to 34% in the police report file), less likely to report driving errors (62% v. 55%), and less likely to report human factor problems (55% to 49%).

Findings

Who Goes to the Chiropractor?

Earlier work with matched cases in Hawaii suggests that the configuration of the crash event, in particular crash type, and driver behaviors (human factors, driving errors, and other fault indicators) are major determinants of injury outcomes (Kim et al., 1995; Kim and Nitz, 1996; Kim et al., 1994). The linked insurance file allows further examination of the role of these factors, along with standard demographic indicators, in the choice of medical and therapy office calls.

In this discussion, we will first present effects that distinguish crash victims who use three classes of therapy: only chiropractic services; only medical services (MD-only); and some combination of chiropractic and medical services. Next we will discuss the patterns of therapy choices for demographic groups, then we will examine care usage for specific crash circumstances.

Relatively few of the crash drivers -- 89 persons, about 7% of the cases with detailed crash data, used only chiropractic services. This is a somewhat unexpected finding, considering the popularity of chiropractic care for auto trauma cases. Forty-four percent of the group using only chiropractic services were male, as opposed to 55% for those using both chiropractic and physician services, and 50% for those using only physician services. The most frequent age group for chiropractic-only use was 21-34 year-olds, with a 53% use rate, as opposed to 45% for those using both chiropractic and physician care and 36% for MD care alone. Those in the 45-64 age group comprised about 10% of the chiropractic service users, compared with 19% of the MD-only users. Seventy-one percent of the chiropractic-only users had no police recorded driving errors, as opposed to about 58% for users of the chiropractic and physician combination users and the MD-only users.

The small number of chiropractic-only users suggests that the group might be combined with those who use both chiropractic and physician services. Over 1,400 cases used a combination of chiropractic and physician services, and 1,105 used only physician services. Grouping all chiropractic users together will permit examination of the question of who goes to a chiropractor in Hawaii.

Table 1.—Chiropractic and Physician Office Visits by Driver Gender

Sex of Occupant	Chiropractic Use		MD Only		Totals	
	N	%	N	%	N	%
Female	722	45.35	550	50.00	1,272	47.25
Male	870	54.65	550	50.00	1,420	52.75
All	1,592	100.00	1,100	100.00	2,692	100.00

Chi-square = 5.64, 1 df, $p < .018$

Table 1 presents the choice of therapy by gender. The MD-only users were evenly split between men and women, while 55% of the users of chiropractic services were men. The pattern of usage by age is shown in Table 2. The age profiles differ significantly ($p<.001$). The 21-34 year-old group constitutes 47% of the chiropractic users, while it accounts for only 37% of the MD-only users. At the higher end of the age scale, the 45-64 year-old group comprises 13% of the chiropractic users, but 20% of the MD-only users. The pattern appears to suggest rapidly declining use of chiropractic services and relatively slower decline in use of MD-only services as individuals age. Other age groups do not differ meaningfully in chiropractic and MD use.

What Is the Relationship Between Occupant, Vehicle, and Crash Characteristics and Choice of Care?

There are slight differences in police-reported seatbelt use for chiropractic and physician service users, with 97% of the chiropractic users reporting belt use, and 95% of MD-only users report having been belted during the crash, as shown in Table 3. The crash report belt use rate is higher than previous independently observed belt use rates in the 80% range. Hawaii has a primary enforcement law for seatbelt violations. The penalties for being unbelted may raise reported belt use rates.

Table 2.—Chiropractic and Physician Office Visits by Driver Age

Driver Age	Chiropractic Use		MD Only		Totals	
	N	%	N	%	N	%

Less than 15	27	1.70	17	1.55	44	1.64
15 - 18	84	5.30	102	9.32	186	6.94
18 - 21	143	9.02	95	8.68	238	8.88
21 - 34	748	47.16	401	36.65	1,149	42.87
35 - 45	302	19.04	215	19.65	517	19.29
45 - 64	212	13.37	214	19.56	426	15.90
65 +	70	4.41	50	4.57	120	4.48
All	1,592	100.00	1,100	100.00	2,692	100.00

Chi-square = 47.76, 6 df, p < .001

Table 3.—Chiropractic and Physician Office Visits by Seatbelt Use

Seatbelt Use	Chiropractic Use		MD Only		Totals	
	N	%	N	%	N	%
Not belted	48	3.17	52	4.98	100	3.90
Belted	1,468	96.83	993	95.02	2,461	96.10
All	1,516	100.00	1,045	100.00	2,561	100.00

Chi-square = 5.4, 1 df, p < .020

The distribution of users of chiropractic versus MD-only care differs in a number of ways across types of crashes. Table 4 illustrates the distribution of care choices across crash types commonly considered "at fault." (The “at fault” drivers are identified as those striking another car, and those involved in rollovers.) The fault profiles of the two usage groups differ significantly. The not-at-fault drivers comprise 58% of the chiropractic users and 64% of the MD-only users. These rates are consistent with a pattern of using services more frequently when another party is felt to be at fault.

Table 4.—Chiropractic and Physician Office Visits by Crash Fault

Fault	Chiropractic Use		MD Only		Totals	
	N	%	N	%	N	%
At fault	540	42.32	287	35.83	827	39.82
Not at fault	736	57.68	514	64.17	1,250	60.18

All	1,276	100.00	801	100.00	2,077	100.00

Chi-square =8.65, 1 df, p < .003

Table 5 illustrates the relationship between care choice and police reported injury severity. The profiles differ significantly (p< .001). Of the chiropractic service users, 64% are reported by police to be "no injury" cases, while only 46% of the MD-only group are reported without injury at the scene. Computing the fraction of each injury level which uses MD-only services indicates that the 34% of those reported as *no injury* use MD services only, the rest using a combination of chiropractic and physician services. Sixty-six percent of those with *incapacitating injuries* using MD-only services, while only 17% use a combination of both chiropractic and physician services.

Table 5.—Chiropractic and Physician Office Visits by Police Reported Injury Severity

Police Injury Severity	Chiropractic Use		MD Only		Totals	
	N	%	N	%	N	%
No injury	853	63.70	447	46.13	1,300	56.33
Possible injury	252	18.82	231	23.84	483	20.93
Non-incapacitating injury	211	15.76	243	25.08	454	19.67
Incapacitating injury	22	1.64	43	4.44	65	2.82
Fatality	1	0.07	5	0.52	6	0.26
All	1,339	100.00	969	100.00	2,308	100.00

Chi-square = 82.21, 4 df, p < .001

Crash type affects the distribution of care choices also, as shown in Table 6. Sixty-two percent of the chiropractic service users were involved in rear-end collisions, while only 54% of the MD-only users were involved in rear-end collisions. Head-on collisions and rollovers account for 3.5% of chiropractic users, compared to 8.1% of MD-only users. Broadside collisions, similarly, account for more MD-only than chiropractic usage (25% to 21%).

Table 6.—Chiropractic and Physician Office Visits by Crash Type

Crash Type	Chiropractic Use		MD Only		Totals	
	N	%	N	%	N	%
Broadside	269	20.53	215	25.29	484	22.41
Head on/rollover	46	3.51	69	8.12	115	5.32
Rear end	816	62.29	458	53.88	1,274	58.98
Sideswipe	179	13.66	108	12.71	287	13.29

All	1,310	100.00	850	100.00	2,160	100.00

Chi-square = 32.29, 8 df, p < .001

Human factors show several small effects on care choice (see Table 7). Chiropractic service users are slightly more likely to have committed misjudgements than MD-only users (12% to 9%), and about half as likely to have been in an alcohol or fatigue related crash as MD-only users (1.4% to 3.5% and 1.3% to 2.1%, respectively).

Table 7.—Chiropractic and Physician Office Visits by Human Factors

Human Factors	Chiropractic Use		MD Only		Totals	
	N	%	N	%	N	%
Inattention	331	20.92	233	21.47	564	21.15
Misjudgement	190	12.01	100	9.22	290	10.87
Fatigue	22	1.39	38	3.50	60	2.25
Alcohol	21	1.33	23	2.12	44	1.65
Other	70	4.42	61	5.62	131	4.91
None	948	59.92	630	58.06	1,578	59.17
All	1,582	100.00	1,085	100.00	2,667	100.00

Chi-square = 22.17, 5 df. P < .001

A variety of driving errors are known to lead to different types of crashes (Kim et al., 1995) Table 8 shows that chiropractic user crashes consisted of 3.5% involving excess speed, while MD-only users involved 4.9% crashes involving excess speed. A similar pattern is found for driving the wrong way: 11% of chiropractic users, and 13% of MD-only users were involved in these types of crashes. (Driving the wrong way includes driving in the wrong lane, crossing the centerline, improper passing, and related offenses.) Following too closely accounted for nearly twice as much chiropractic as MD-only use -- 9.5% of chiropractic users followed too closely, while only 5.3% of the MD-only users did so.

Table 8.—Chiropractic and Physician Office Visits by Driver Errors

Driver Errors	Chiropractic Use		MD Only		Totals	
	N	%	N	%	N	%
Excess speed	56	3.53	54	4.94	110	4.10
Disregard controls	20	1.26	28	2.56	48	1.79
Driving wrong way	174	10.96	146	13.36	320	11.94
Improper turn	8	0.50	2	0.18	10	0.37
Following too closely	145	9.13	58	5.31	203	7.57
Other	150	9.45	121	11.07	271	10.11
None	1,035	65.18	684	62.58	1,719	64.12

All	1,588	100.00	1,093	100.00	2,681	100.00

Chi-square = 29.08, 6 df, $p < .001$

Summary and Discussion

The set of police crash report records matched to insurance claim records is associated with higher levels of injury than the unmatched police reports. It also has a larger proportion of females than the overall police report population. Typical environmental variables, such as time of day and intersection vs. mid-block location, show no meaningful differences between the matched and unmatched cases. The principal distinguishing factor in the reported crashes which match to insurance records appears to be the severity of injury -- more severe injuries result in more frequent insurance claims.

This study provides new and useful information about the choice between traditional medicine, and approaches which rely to some degree on alternative forms of care, in this case, chiropractic care. Several conclusions emerge from the analysis:

- persons who are "not-at-fault" (usually the struck party) use MD and chiropractic services more frequently than those "at-fault;"
- the use of chiropractic services is substantially higher than the use of MD-only services among occupants with low severity police reported injuries;
- those who commit what might be seen as the most serious driving errors in the course of a collision (driving on the wrong side, ignoring traffic controls, speeding) are less likely to use chiropractic care than those who commit no errors or more minor errors (e.g., following too closely, inattention, misjudgment);
- when the driver has been impaired by alcohol, the use of chiropractic services is about half the level of use of MD-only services; and
- more chiropractic services are used by men than women, particularly in the ages of 21 to 34.

Our study has a number of limitations. The first stems from the nature of the auto insurance market in Hawaii: no single insurer holds a very large share of the total market, so the number of policies, and thus claims paid by each insurer are relatively small. The second is that the data spans only a portion of a time period in which three substantial changes have been made to Hawaii's motor vehicle insurance laws. The third is the restriction of the present analysis to choice of care, rather than total cost of care.

There is decidedly a need for additional research to address these limitations. Case files from additional insurers would increase the pool of claims, and allow exploration of whether company practices affect claim patterns. Extending the time period covered from 1990-91 through 1995-96 would span a major change in the way chiropractic charges were to be reimbursed under Hawaii motor vehicle insurance policies, providing a natural quasi-experiment. This would allow a test of the effect of subjecting chiropractic treatment to the workers' compensation schedule.

New research questions on choice of therapy could extend the results of this study by examining some questions not raised in the present study.

- That is the relationship between fault and the quantity and cost of chiropractic or other alternative care used?
- How do drivers' prior histories in terms of traffic violations or insurance claims affect the nature of the care they choose when injured in a collision?
- How would the patterns of choices and costs of care differ in a pure tort law state?
- There is clearly a need for more research on the role of crash and occupant characteristics in choice of therapies.

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